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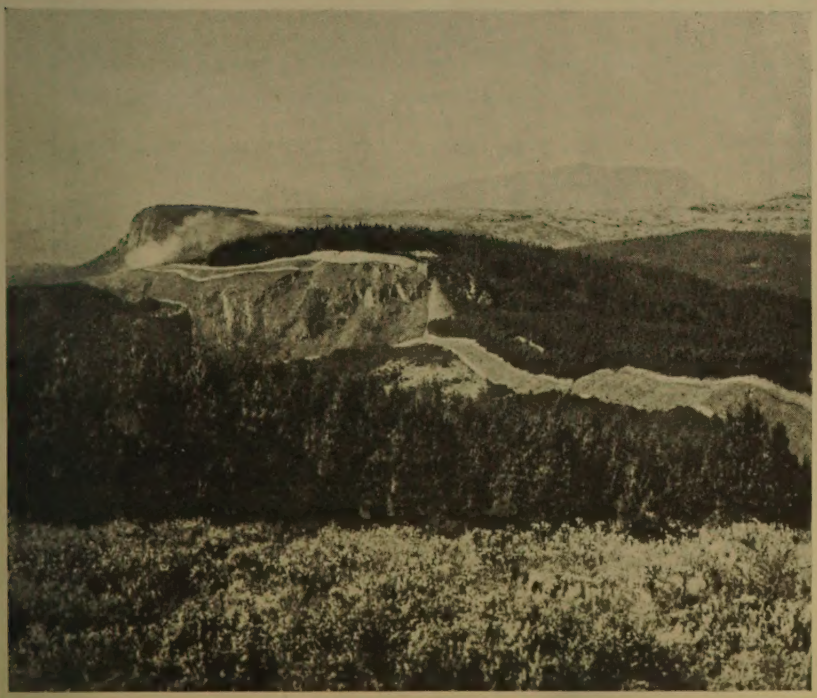

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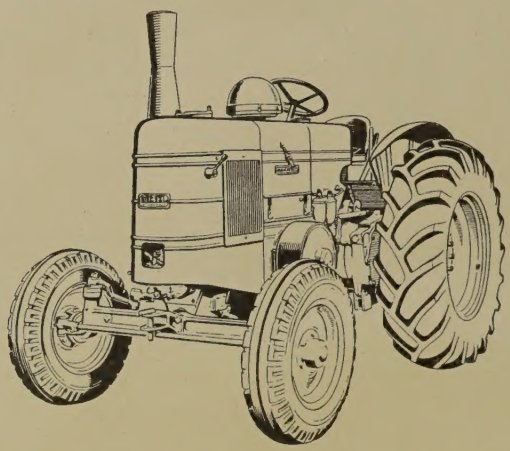

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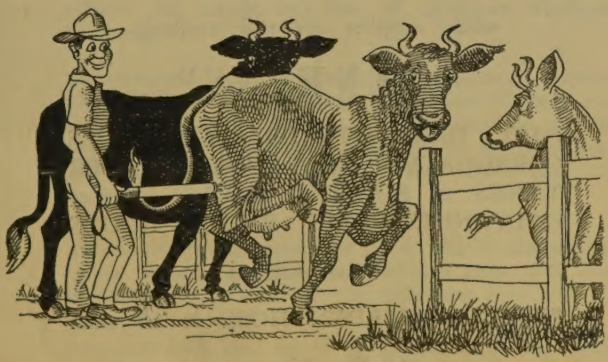

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Agricultural Journal

THE JOURNAL OF THE MINISTRY OF AGRICULTURE
Southern Rhodesia

Editress: Marie H. Pardy, B.Sc.

(Assisted by the Staff of the Division of Agriculture and Lands)

Vol. 49, No. 2 March-April, 1952

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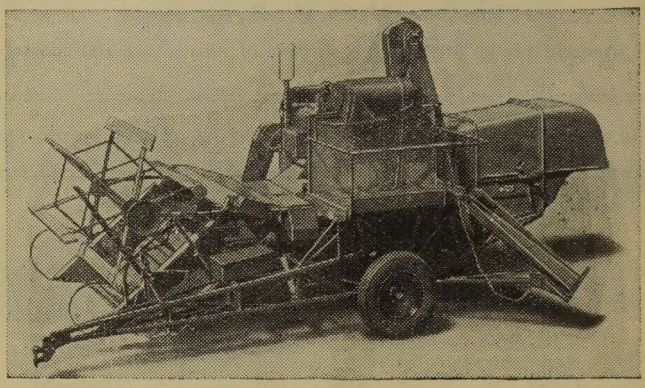

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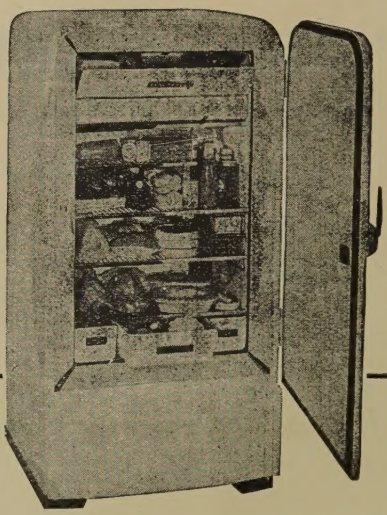

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THE RHODESIA
Agricultural Journal

Vol. 49, No. 2 March-April, 1952

Editorial

Notes and Comments

FARMERS' DAY AT PROSPECT TOBACCO STATION.

The first farmers' day under the new set-up of the Tobacco Research Board was held at Prospect on Wednesday, February 6, and was very well attended.

The Minister of Agriculture (Mr. J. M. Caldicott) gave a short account of the history of tobacco research in the Colony, from its early beginnings to the present day organisation, which is in the nature of a partnership between the Tobacco Industry and the Government. As a result of this, the present Research Station at Prospect will become the central station for the Colony.

Dr. F. A. Stinson, Director of Tobacco Research, said that although the station had been established only a few months ago yet good progress had been made.

A tour was made of the experimental plots.

The experimental work at Prospect is being carried out to provide information to growers of flue-cured tobacco in this Colony. The tobacco land on the station is coarse sand of uniform type, with a small granite outcrop, but relatively free from ant heaps.

The sand veld is medium and low in organic matter and fertility.

The area set aside for tobacco was cleared before the first rain and ploughed in October.

In the tobacco land the ground has an east to west slope of 2 feet in 100 feet. As there is a slight slope from south to north, it is possible to use the 18 feet roadways between the ranges of plots to carry off excess water. A broad-base terrace, sufficiently high to contain the run-off from a 78 feet strip of land, has been formed on each roadway with a one-way disc. All roadways will be under grass.

Each plot is approximately 1/50 and 3/100 acre in extent, consisting of 4-6 rows respectively and 60 feet long.

Two-row plots are utilised for preliminary testing of tobacco varieties and strains. Treatment of the plots is based on modern scientific methods.

Experiments are also being conducted on fertilisation, seed-bed management, varieties, crop rotation and crop management, including cultivation, priming, topping and suckering.

Nursery plots of several perennial grasses and two legumes have been laid down to study their adaptability for future use on this type of soil.

A Farmers' Day was also held at Trelawney the following day, when the meeting was opened by Mr. Eric Palmer.

A large and interested gathering of tobacco growers attended and particular attention was paid to the plans for breeding varieties immune to mosaic, and also to the experiments for eel-worm control by means of an electric current generated on a tractor.

On Thursday, February 14, the Farmers' Day at the Karoi Experimental Station was held. Mr. G. H. Hackwell, M.P., made an opening address.

Attendance was good, despite heavy rains the previous day and the threat of more to come.

"GWEBI COLLEGE ECHOES."

As we go to press an excellent Gwebi College publication, entitled "Gwebi College Echoes," has just made its appearance.

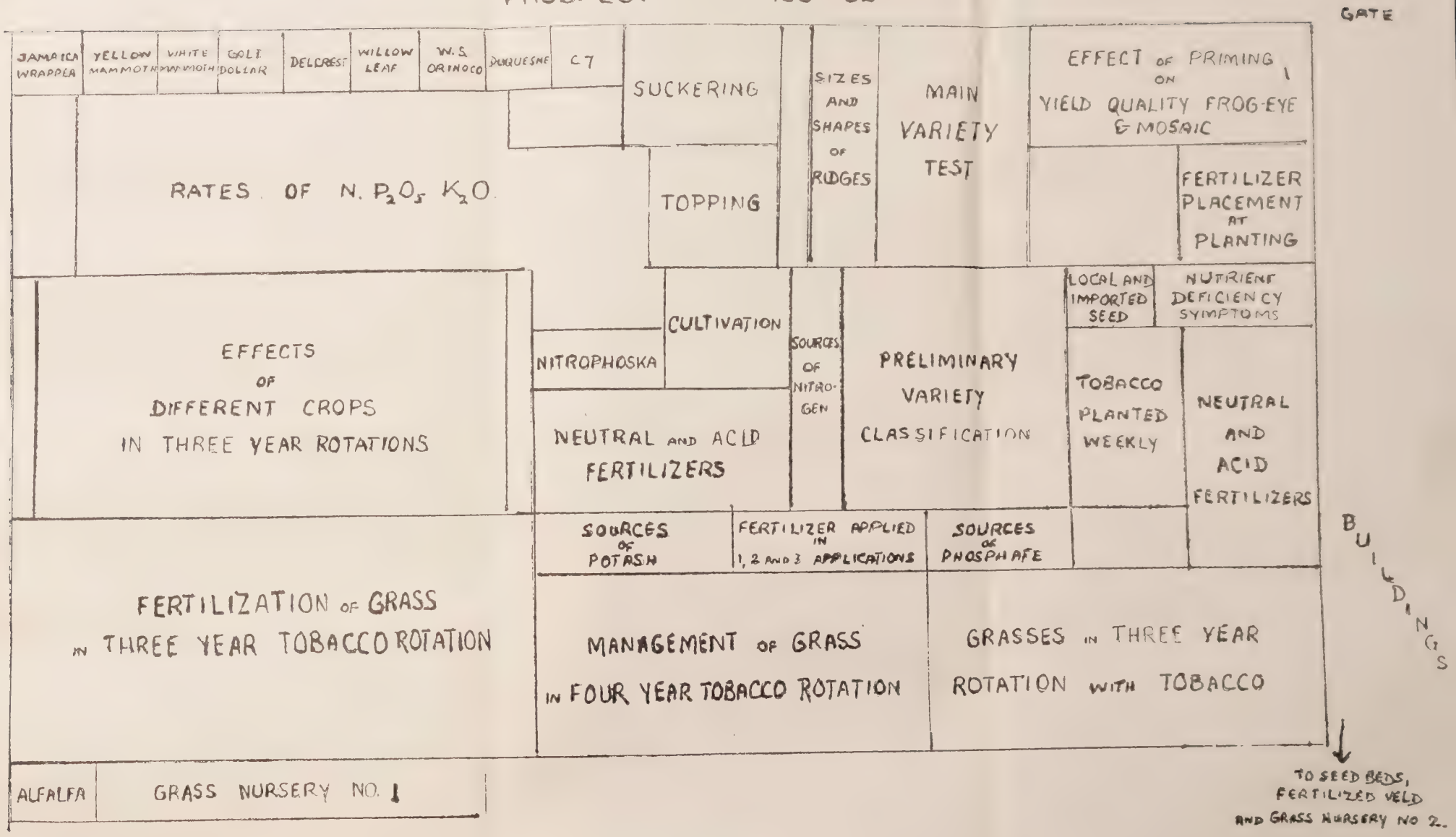
It contains a foreword by the Prime Minister, the Rt. Hon. Sir Godfrey Huggins. Subject matter in this publication varies from the serious to the light.

It is obtainable from booksellers or from Gwebi College at a cost of 2s.

All proceeds go to the College Funds to provide sports and recreational facilities for the students.

PLAN OF TOBACCO PLOTS

PROSPECT —— 1951-52



Notes on Freshwater Fishes in Southern Rhodesia

A CATALOGUE OF THE MORE COMMON INDIGENOUS SPECIES.

By R. A. JUBB, B.Sc.

FAMILY CICHLIDAE: The African cichlids or bream.

In Africa the cichlids are the most important of our freshwater fishes and, as a food, are eagerly sought after by all races. Lake Nyasa provides about 20 million pounds weight of various species of cichlids as food a year; this figure may appear phenomenal at first, but, the lake has a surface area of over seven million acres! Feeding habits result in only a small portion of this vast area of water being able to support cichlid populations, and it is the shallow waters that yield most of this crop.

It has been found that certain members of this family, of the genus *Tilapia*, respond to pond breeding and, if the correct food chain is provided, give annual yields of 5,000 lbs. and over of fish as food per acre of water; this is, of course, in tropical and sub-tropical areas. Fish farming is becoming increasingly popular, but, as the technique is specialised and involves manuring and fertilisation of the water, such large yields cannot be expected from dams supplying drinking water or irrigation dams with greatly fluctuating water levels.

Lake Nyasa has a geological history of a little over one million years, and in it there are 174 endemic species of cichlids; they have actually evolved in the lake and are found nowhere else in the world. Other African lakes also have their endemic species, and the study of the evolution of the large number of cichlids is receiving much attention. Originally there were about 46 species of cichlids recognised from our rivers, but recently Dr. Barnard revised the South African cichlids [1] and there are 20 accepted species of which only seven are really common in the rivers of Southern Rhodesia.

The breeding habits are interesting and differ greatly from most other fishes, in which there is a mass congregation of both sexes at what one might call hereditary breeding or spawning spots where the eggs are laid and fertilised and the resulting young left to fend for themselves. The cichlids guard their young very carefully during the first six weeks of their lives, after that the young tend to become troublesome and eventually leave their parents to shoal with other young of the same species. The breeding season is closely associated with the temperature of the water and is therefore most common during the hot months October to December. The male cichlids assume a distinctive breeding colour and the majority of species set about hollowing

out a nest in the sandy bottom of the river or pool, where the chosen female lays her eggs and has them fertilised. The female then picks up as many eggs as she can in her mouth and carries them around until the young hatch. For some weeks after the young hatch the female parent remains in attendance and takes them back into her mouth at the slightest sign of danger. These cichlids are known as mouth breeders. Other species prepare a place for the laying of the eggs, such as a hollow or the clean surface of a stone, the eggs are laid and fertilised, then one or other of the parents remains in constant attendance fanning water over the eggs and guarding them. Once the young hatch and shoal, both parents guard the shoal and will furiously attack any fish that may venture too near the young family.

The cichlids are distinguished from other freshwater fishes by their long and spiny dorsal fin and broken lateral line. More detailed determinations involve scale counts, body dimensions and the gill-raker count [2]. In counting the gill-rakers it is the number along the lower arch of the anterior gill arch. In the diagram "A" has eight gill-rakers and "B" has 18 gill-rakers; the gill cover has been cut away to expose the gills.

Genus *Tilapia.*

Tilapia sparrmanii. A. Smith. Fig. XXIX. Bream, striped bream or barred kurper.

Native Name: the most common name is "m'gwaai" or "m'kwao."

Distribution.—Except for the mountain streams along the eastern border, this fish is found in all our rivers. *T. sparrmanii* is common in the rivers of the Transvaal and Central Africa, and, together with *Tilapia menalopleura*, is one of the very few non-endemic species of the cichlids of Lake Nyasa [3].

General Description.—The general colour is silvery light green with nine distinct vertical dark bars. The dorsal fin, which has 13 to 15 spines, is edged with red and, except for some mature adults, there is a dark spot just where the soft portion of the fin begins. In the case of young *T. sparrmanii* this spot is most conspicuous and is edged with white, the spot itself is oval shaped with the axis sloping the same way as the rays. During the breeding season the dark bars become black and broaden out to give two lateral black lines as well, the throat and ventral fins becomes very dark and the fish could be mistaken for a different species. Mature adults grow to about eight inches in length and their colour becomes bronze green. *T. sparrmanii* are useful as a forage fish for black bass.

T. sparrmanii is not a mouth breeder but both parents guard the eggs and young assiduously [4].

Tilapia melanopleura. Dum. Fig XXX. Bream, Sabi bream, rainbow bream, red-fin bream, small-mouthed kurper.

Native Name: Upper Zambesi, "Mbofu"; elsewhere, as the fish is not generally distributed, "m'gwaai."

Fig. XXIX. Striped bream (*Tilapia sparrmanii*).
Live fish photographed in aquarium.
[Photo. by R. A. Jubb.

Fig. XXX. Sabi bream or rainbow bream (*Tilapia melanopleura*).
[After Gilchrist and Thompson.

Fig. XXXI. Bream (*Tilapia mossambica.*
[After Gilchrist and Thompson.

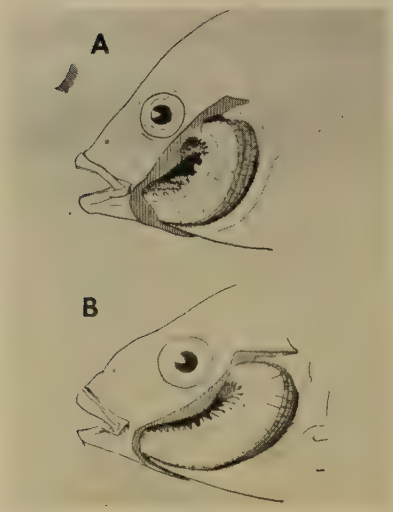


Diagram showing gill-rakers, gill cover has been cut away.
A. Gill-raker count is eight. B. Gill-raker count is eighteen.
[After Bertram, Borley and Trewavas,
by kind permission of the British Museum.

Bream or Kurper (*Tilapia mossambica*).
A fine specimen from the ponds at "Inverness." [Photo. by R. A. Bourlay.

General Distribution.—This fish is common in the Upper Zambesi and the Kafue River above the Kafue Gorge. It is not a all common in the Zambesi River below the Victoria Falls, neither is it common in Lake Nyasa. It is not found in the Sabi River system above the Chirabira Falls or the Lundi River above the Chipinda Pools or Selawandoma Falls. As far as the Lundi River is concerned this distribution may have to be modified, as *T. melanopleura* were transported from below the Chirabira Falls on the Sabi River to the Umshandige dam near Fort Victoria, where they have flourished, and it is known that some have escaped into the Tokwe River. This species is fairly common in the Transvaal rivers and the Limpopo.

General Description.—A deep fish which grows to an average length of 12 inches and a weight of 2½ lbs; rare specimens of 4 lbs. and slightly over have been caught and recorded. The general colour is dark grey-green or brownish-green with about six dark vertical bars on the sides. In the live fish the scales along the sides have iridescent rainbow colours and the throat is rose pink, which colour sometimes extends along the belly, the ventral fins and the anal fins. A magnificent fish which has become popular for sport and the table. *T. melanopleura* are chiefly vegetarian in diet and are thus particularly useful for fish farming or stocking of dams. They can be caught using earth worm as bait and, on very rare occasions, have been known to take a small lure used for black bass.

Young *T. melanopleura* are very similar to young *T. sparrmanii*, but there is little difficulty in recognising young *T. melanopleura* of one to two inches amongst *T. sparrmanii* of the same size. The former have pink throats, ventral fins and anal fins, and six vertical dark bars, the latter have silver white throats, silver-grey ventral and anal fins, and nine vertical dark bars. Both fish have a pronounced black spot at the beginning of the soft part of the dorsal fin, but the oval shape of the black spot in the case of *T. melanopleura* has an axis at right angles to the slope of the rays, whereas in the case of *T. sparrmanii* the axis slopes with the rays. This latter characteristic is a great help in determining the difference between specimens preserved in formalin. Another marked difference is the black stripe which goes through the eye in the case of young *T. sparrmanii* and which appears only in the breeding plumage of adults; there is no stripe in the case of *T. melanopleura*.

It should be noted that *T. melanopleura* are not suitable for breeding in cold waters, and this probably accounts for their absence in the plateau tributaries of the Zambesi. However, through the courtesy of the Fort Victoria and District Angling Society and with the assistance of Mr. H. P. Dimmock, Curator of the Umshandige dam, the writer and Mr. Pocock successfully transferred about three dozen young *T. melanopleura* to Salisbury, where they have been established in the ponds of Mr. H. W. Wallis of "Inverness," and these fish, in less than a year, have bred and a foundation stock is now available for scientific and experimental purposes.

T. melanopleura are not mouth-breeders [5]; a nest is prepared either on a flat stone or depression in the pool or pond and the parents guard the eggs and young when hatched, rather similar in fact to the domestic duties carried out by *T. sparrmanii.*

Tilapia mossambica. Peters. Fig. XXXI. Bream.

Native Name: "m'gwaai" or " "m'kwao."

Distribution.—All the rivers which flow into the Indian Ocean from East Africa to Algoa Bay, but has not been found in the Zambesi above the Victoria Falls or in Lake Nyasa. Locally it is common, and its distribution has been accelerated by the fact that *T. mossambica* is a popular fish for pond breeding and stocking of dams. Very common in the Sabi River system.

General Description.—Adult fish vary in colour from dark brown-green with light belly to silver-grey with about six vertical dark bars. The top of the dorsal fin and the tail are edged with red. The young are typical bream shape with irridescent rainbow colours along the sides and no black spot on the dorsal fin like the previous two species. In the case of adults, you can distinguish this species from the previous two by counting the gill-rakers; *T. sparrmanii* has 9-12, *T. melanopleura* has 8-10, and*T. mossambica* 14-21.

T. mossambica is a mouth breeder; nests are prepared by the males, and, after some display, the selected female lays her eggs in the nest where they are immediately fertilised. The female then takes what eggs she can into her mouth and carries them around thus until they hatch. The ova are retained in the mouth for a few days and then the shoal of fry ultimately released to feed, but, at the slightest sign of danger, the young return to the mouth of the female parent. Young thus carried have been found to survive a journey of many miles and a period of nearly three hours out of water. Breeding males become very dark along the underparts just below the gills; the females remain silvery-white. Breeding activity starts when the water warms up and there will be as many as five broods in a season. Whenever possible anglers should replace female fish caught carrying eggs or fry in their mouths; the eggs look like kaffir corn.

From an angling point of view and as a table fish *T. mossambica* is well worth cultivating and catching. The usual size of adults is about 1½ to 2 lbs., but frequently some real old warriors turn up and several of 4 to 5 lbs. will be caught in the same spot on the same day. The fish is omnivorous but the best bait is earthworm using a small hook and gut trace; a float is usually used with the bait set at about three feet. Crushed water snails and grasshoppers are also good bait.

It is of interest to note that *T. mossambica* is equally at home in salt water lagoons and has recently been found breeding in the saline area of a tidal river near Algoa Bay [8].

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WARNING TO POULTRY BREEDERS

BACILLARY WHITE DIARRHOEA (B.W.D.)

This serious disease of poultry is known to exist in Southern Rhodesia, and purchasers of hatching eggs and day-old chicks are hereby warned of the grave danger of introducing infection into their flocks if they purchase from breeders who are not in possession of a valid certificate of freedom from B.W.D. infection in respect of their flock. Any intending purchaser may, on application to the District Veterinary Officer, be advised whether the flock from which he intends buying is in possession of such a certificate or whether infection is known to exist in it.

Mature breeding birds, which might be carriers of infection, should be tested prior to their introduction to poultry premises, for which application should also be made to the District Veterinary Officer.

WARNING: BUY YOUR DAY-OLD CHICKS ONLY FROM CERTIFIED B.W.D. FREE FLOCKS.

Notes on Indigenous Trees and Shrubs of Southern Rhodesia

Thespesia garckeana F. Hoffm. (Malvaceae)

Common Name: Snot Apple. **Native Names:** Mutohwe, mutobge (Chis.); ixaguxagu (Sind.)

General Description.—This is a small tree which grows to a height of about 15 feet. It is common in this Colony and is one of the host plants of the so-called cotton stainer. The simple 3-5 lobed leaves are alternate. The blade is about 3 inches by 4 inches and has on it, both on the upper and lower surfaces, star-shaped hairs and at the back of the leaf on the main central vein there is a characteristic mark resembling a scar. There are small stipules, but these fall off early. The flowers, which grow singly in the axils of the leaves, are large, bell-shaped and of a showy yellow colour with reddish-brown markings inside. They are to be seen during January and early February. The fruits, which have a dense outer covering of hairs, are capsules with an inner mucilaginous layer and open by means of five valves. The bark is of a brownish colour and somewhat rough and hard.

Distribution.—This small tree is widely distributed in this Colony at medium and lower elevations. It occurs in Central Africa generally.

Uses.—Apart from the fruits being eaten by natives, no special uses are known.

Thespesia garckeana.
Habit photo.
[Photo. by A. A. Pardy.

Thespesia garckeana.
Leaves, flower buds and a flower.
[Photo. by A. A. Pardy.

Thespesia garckeana.
Leaves and Fruit.
[Photo. by A. A. Pardy.

Syzygium guineense (Willd.) DC. (Myrtaceae)

Common Name: Water Tree. **Native Names:** Mukute (Chis.)

General Description.—The mukute, which is a common tree, is normally found where conditions are fairly moist, such as along the edges of vleis. It normally grows to about 25 feet in height, but may be found taller than this, and sometimes forms groves. The leaves are evergreen, opposite, simple and without stipules. This species has a distinct, channelled petiole or leaf stalk, which is one outstanding difference when compared with the leaves of *S. cordatum* Hochst which is also a common water tree. *S. cordatum* has practically no leaf stalks. The leaves of *S. guineense* are of an oval shape, leathery and shiny. The sweet-scented white flowers are in bunches usually at the ends of twigs. The whiteness of the flowers is due to the large number of stamens as the petals fall off as the flower opens. The fruit is a red or purple berry up to the size of a small plum. The bark is of a darkish colour and not very rough.

Distribution.—This is a common tree throughout this Colony from upper medium to lower elevations. It also occurs elsewhere in Central and Southern Africa.

Uses.—When of sufficient size the timber, which weighs about 45 lbs. per cu. ft. air dry, can be used for frames, flooring, etc. It is not difficult to saw and plane. The edible fruits are favoured by monkeys and birds and particularly by green pigeons.

Syzygium guineense.
Habit photo.
[Photo. by A. A. Pardy.

Syzygium guineense.
Leaves and flowers.
[Photo. by A. A. Pardy.

Syzygium guineense.
Leaves and fruits.
[Photo. by A. A. Pardy.

Combretum microphyllum Klotzsch (Combretaceae)

Common Name: Scarlet combretum. **Native Name:** Pfurura (Chis.)

General Description.—This is a scrambling shrub. The leaves are opposite, simple, of an oval shape and slightly hairy. The petioles are $\frac{1}{4}$-$\frac{1}{2}$ inch long and the leaf blades are up to $2\frac{1}{2}$ inches in length. Brownish hairs are conspicuous on the petioles and can also be seen along midribs and veins on the under surfaces. There are no stipules. On the branches are rough protruberances where there had previously been leaves. The flowers, which appear mainly during September, are massed in short spikes on the long straggling branches. On account of their density and bright red colour they are visible from a considerable distance. The fruits, about $\frac{3}{4}$ inch long, are four-winged and somewhat membranous. In cross-section the fruit is in the form of a cross.

Distribution.—This shrubby combretum is found at lower altitudes, being found, for example, in the Shamva and Sabi Valley areas. It also occurs in adjoining territories.

Uses.—No uses are known apart from its possibilities as an ornamental plant.

Combretum microphyllum.
Habit photo.
[Photo. by A. A. Pardy.

Combretum microphyllum.
Leaves, flowers and fruits.
[Photo. by A. A. Pardy.

Stereospermum kunthianum Cham.
(Bignoniaceae)

Common Name: Pink jacaranda. **Native Name:** Mukuku (Chis.)

General Description.—This tree, which generally speaking is not common, is most striking when in flower during October. It grows to a height of about 25-30 feet but may be a little taller. The crown is branching and somewhat rounded. There are both long and short shoots. The leaves are in opposite pairs and are imparipinnate (i.e., there is an odd leaflet at the end) with 5-9 noticeably stalked leaflets of an oval shape, fairly stiff and more or less pointed. The flowers, which appear before the leaves, are in large panicles, each flower being bell-shaped and of a pink colour. When in flower the tree is reminiscent of the exotic purple-flowered jacaranda. The fruits, which look like pods, are narrow and up to a foot or even more in length. They contain winged seeds in small pits in the cylindrical central part of the "pod." The bark is smooth and somewhat flaky.

Distribution.—The pink jacaranda which grows at medium and lower elevations is usually not often seen. When, however, it is seen in full flower it is a sight not readily forgotten. It occurs for example in the Salisbury, Umtali, Gatooma, Sinoia and Shamva areas.

It is widely distributed in Central Africa and is found as far north as the Sudan.

Uses.—No use is known to be made of this tree and, as it is not very common and is of such outstanding beauty when in flower, it would be a great pity to see this tree felled. It is stated that in Tanganyika natives chew the pods with salt for coughs.

It germinates easily from seed and, although of somewhat slow growth, it would be well worth establishing as an ornamental tree.

Stereospermum kunthianum.
Habit photo.
[Photo. by A. A. Pardy.

Stereospermum kunthianum.
Leaves on short shoot.
[Photo. by A. A. Pardy.

Stereospermum kunthianum.
Leaves on long shoot.
[Photo. by A. A. Pardy.

Stereospermum kunthianum.
Flowers.
[Photo. by A. A. Pardy.

Stereospermum kunthianum.
Fruits.

[Photo. by A. A. Pardy.

Afzelia quanzensis Welw.
(Caesalpiniaceae)

Common Name: Pod mahogany. **Native Names:** Mukamba (Chis.); umkamba (Sind.)

General Description.—The pod mahogany is a tree up to 60 feet in height, with a spreading crown and of attractive appearance. It is leafless during the latter part of the dry season. The new leaves and flowers appear during October. The dark green, shiny, somewhat drooping leaves are alternate and paripinnate (i.e., no odd leaflet at the end). There are 4-7 pairs of opposite, thickish, wavy-edged leaflets which are often notched at the tips. The leaves are stipulate. The petiole or leaf stalk is twisted and noticeably swollen at its junction with the twig. The sweet-scented flowers are in few-flowered racemes. Each flower has only one petal, which is conspicuous and of a reddish colour. The stamens and young pod portion of the flower are long. The mature pods are thick, hard, woody, and up to 6 inches long. They are dark-coloured outside and white inside. Each pod contains several of the well-known large pod mahogany beans. These beans are black and each has a hard scarlet aril or cup. The bark is thick, fairly smooth and varies in colour from light to dark grey with characteristic prominent lighter coloured circular patches on mature trees.

Distribution.—The pod mahogany occurs at medium and lower elevations and usually as a very scattered tree.

It is also found in adjoining territories.

Uses.—The heartwood of this tree is of a brownish colour becoming dark red on exposure. It weighs about 50 lbs. per cu. ft. air dry and is hard and durable. It is suitable for wheel naves, coach building, high-class joinery and furniture and also makes good parquet flooring blocks. A good deal of this timber is imported into Southern Rhodesia from Portuguese East Africa under the names of chamfuta and mussacossa.

The beans are popular for ornamental purposes, e.g., for brooches.

The tree can be easily raised from seed and makes a fine ornamental tree but is of rather slow growth. It is better to put the seeds in prepared patches where it is intended the trees should grow rather than raise elsewhere and transplant.

Afzelia quanzensis.
Habit photo.

[Photo. by R. Davies.

Afzelia quanzensis.
Leaves and flowers.

[Photo. by A. A. Pardy.

Afzelia quanzensis.
Pods.

[Photo. by A. A. Pardy.

Combretum gueinzii Sond.
(Combretaceae)

Common Name: ——— . **Native Names:** Mugodo, mupembere (Chis); umbondo (Sind.)

General Description.—This Combretum, which was previously known botanically as *C. holosericeum* Sond., is a common tree usually about 20-25 feet in height and seldom exceeding 30 feet in height. The leaves are simple (i.e., not divided), opposite, softly hairy and are without stipules. The leaf stalk is short and the blade, of an oval shape and pointed at the end, is up to 4 inches in length. The spikes of scented yellow flowers make the leafless trees conspicuous during September and early October in a good flowering year. The new leaves appear soon after the flowers have made their appearance. Later, and particularly as the trees become leafless towards the end of the dry season, the four-winged fruits, about ¾ inch long, are conspicuous. The bark of the smaller twigs is characteristically stringy. The bark of the stem and larger branches is of a grey colour and in small rough squares.

Distribution.—The mugodo is a common tree of medium and lower elevations and may even be found along the lower fringes of the mountainous area of the Eastern Border. It also occurs in adjoining territories.

Uses.—This tree is usually either not straight enough or the bole too short to be of much use other than as firewood. It is, however, used to a certain extent for tool handles and when straight enough, for roofing rough buildings. When in leaf the mugodo is a fine shade tree and so is very useful in grazing areas.

Combretum gueinzii.
Habit photo.
[Photo. by A. A. Pardy.

Combretum gueinzii.
Young leaves and flowers.
[Photo. by A. A. Pardy.

Combretum gueinzii.
Leaves and fruits.
[Photo. by A. A. Pardy.

Thrushes and Chats

TURDIDAE.

By CAPTAIN G. L. JAMES,
Hon. Ornithologist, Queen Victoria Museum, Salisbury.

Ground-scraper Thrush. *Turdus litsitsirupa.*—A common, well-distributed species, though seldom more than a pair are to be seen in a locality. It spends the greater part of its time on the ground scratching amongst fallen leaves for insects or searching lawns for grubs. This bird runs with celerity with body held parallel with the ground, but otherwise it stands upright, exposing its underparts and displaying the tear-shaped spots on a white ground which makes identification easy. The sexes are alike.

The nest is constructed of pliable stems of small, everlasting, red and white flowers, giving the nest an attractive appearance. When this plant is not available, bent and dried grasses are used or, if near habitations, string and pieces of rag are used externally. The nest is deep, cup-shaped and lined with rootlets and fibres. It is always placed in a vertical or lateral fork of a tree at heights varying from 10 to 25 feet. It is usually found near water, and the foundation of the nest is often held in place by mud.

The eggs are very pale greenish-blue in ground colour, covered with spots and blotches of dark and light purplish-brown superimposed on pale lilac. Markings are usually more numerous at the larger end. They vary in size from 29-32 x 18-26 mm.

Kurrichaine Thrush. *Turdus l. libonyanus.*—This is the commonest thrush in the Colony and is to be seen in any woodland area providing water is nearby. It does not wander far from its chosen habitat. It is a handsome bird; generally grey in colour with chestnut-buff on the flanks and white underparts; bill, orange; legs and left feet, yellow.

Insects, which form its principal diet, are searched for on the ground amongst decayed vegetation. This thrush will take berries but not seeds. It runs in the usual thrush manner, with the body parallel to the ground, but rises upright as soon as it stops.

The nest greatly resembles that of the Ground-scraper, being constructed of similar materials and placed in similar positions, though as a rule not so high. There has been much discussion regarding the use of mud in the nest, but in my experience mud is only used in the foundation. When constructing its nest the bird will sit down as though brooding and rotate from side to side pressing the breast against the inside of the walls, the position is then changed and the rotating movement repeated

and, as a result, the interior is made smooth and round. The nest of this species is usually more tidy than that of the Ground-scraper.

The eggs, usually a clutch of three, are darker and of a richer greenish-blue than those of the Ground-scraper, often varying in richness. The marking may be small spots or large blotches more concentrated at the obtuse end. They measure 23-26.5 x 17-19 mm.

Swynnerton's or Melsetter Thrush. *Turdus swynnertoni.*—This species is peculiar to the Colony, being unknown beyond our borders. It is confined to the Mount Selinda forest area, and being shy it mostly frequents dense woods near streams, either singly or in pairs.

The nest is a heavily built cup-shaped structure of mud, roots and tendrils, lined with fine rootlets, and is placed in the fork of a tree some ten feet from the ground. The nest is usually damp owing to its position, as the sun seldom reaches it.

It lays two to three eggs of a deep blue-green, spotted and blotched with dark red-brown over the whole surface. Measurements, 26 x 20 mm.

Angola or Mottled Rock Thrush. *Monticola angolensis.*—Its name is a misnomer, as this species has no special liking for rocky country, being more partial during the summer period to woodlands, near water, where it nests. It appears to have a local movement, disappearing from its breeding haunts during the colder months. Nothing is known of its movements. It is insectivorous, feeding on the ground amongst dead leaves and decayed vegetation.

A description of the nest and eggs, with photographs, appeared in Vol. XLVII, No. 6 (Bulletin No. 1552). It appears that eggs have been found both immaculate and also spotted with dull red-brown. Eggs so marked were found by Sir Charles Belcher in Nyasaland.

Capped Wheatear. *Œnanthe pileata livingstonei.*—A tame and confiding species frequenting camp sites and cattle kraals and any grassland where the grass is short or newly burnt. They appear to have a local movement, arriving about July and disappearing during the rains; a few may remain and are not noticed. They are insectivorous and spend most of their time perched on ant hills, small plant stems or stones, from which they dart after passing insects.

They nest underground in the deserted hole of some small mammal such as a Gerbille Rat. These holes go down some two feet and open into a chamber six inches by four or five inches, where the bird makes a platform of dried grass up to two inches thick, on which it builds a flat saucer-like nest of grass, lined with finer grass and pieces of animal fur.

The eggs, usually three to four, are a pale bluish-white or white, and are unmarked; they measure 22.5 x 17.5 mm.

Capped Wheatear.

Young birds when first leaving the nest differ in markings from the adult, being of a uniform dove-grey on the head, back and wings. The underparts are ashy-grey without the black band across the chest. Bill, black; legs, grey; iris, black. They have a yellow line running from the gape to the ear coverts.

Familiar Chat. *Saxicola familiaris.*—A very local and uncommon bird found in the northern part of the Colony but more plentiful in the southern portions. Friendly and confiding, showing a preference for the habitations of man. It is said to have a liking for fat, hence its Afrikaans name of Spekvreter (Fat Eater). They are insect feeders, very restive and active, flitting from place to place, raising and lowering their wings and tails upon alighting.

The nest is a shallow saucer-shaped untidy structure of dry grass lined with feathers, wool or hair, placed in the hole of a rock, a wall or under a stone. It is frequently placed on or behind a foundation of small stones, which also serve as a screen.

The eggs, three in number, are of a bright blue ground colour-zoned with rust-coloured spots round the obtuse end and measure 20 x 15 mm.

There is a sub-species, *falkensteimi*, found in the northern parts of the Colony.

White-shouldered Bush Chat or Mocking Chat. *Thamnoloea c. cinnamomeiventris.*—A local bird found in suitable localities amongst large rocks in wooded country. It is shy in some cases, tame and confiding in others. It is a very handsome bird which attracts attention on account of its conspicuous colours. The underparts are cinnamon-red, which contrasts well with its general black coloured plumage. The male, as its name indicates, has a white patch on the shoulder, but this marking is absent in the female. Its song is of no mean order and it is stated to be able to imitate the song and calls of other birds. It is lively and spends much time hopping about over and amongst rocks and bushes, with occasional flights to the ground after ants, beetles, flies, grasshoppers and sometimes a few small seeds. It will fly straight to the face of a perpendicular rock, alight, and hold on with ease.

They nest usually in old swallows' nests, especially those built under an overhanging rock. It has been stated that they do not use the retort-shaped type of swallows' nest, but if they do they first break away the tunnel. A pair nested at Prince Edward Dam in a retort-shaped nest without removing the spout, and for some reason the entrance was filled with grass and spiders' web. The nest was inaccessible and the petrol shortage made observations impossible. An alternative nesting site is a crevice amongst rocks. The nest is lined with fibres and hairs.

The three eggs, which form the clutch, are pale greenish, thinly clouded with speckles of slate and rufus, more concentrated at the thick end. They vary in size from 24.5-25.5 x 18-18.5 mm.

They are stated to have two broods a year during the period September to January.

Arnotts' Bush Chat. *Thamnoloea arnotti.*—Another handsome black and white chat to be found in park-like country in the low-lying parts of the Colony, with a marked preference for mopane tree areas. It is lively and active, spending its time searching the tree trunks—usually low down—for insects, with only occasional trips to the ground. It is commonly found in small parties. Reports are conflicting, some stating the bird is shy, others remark on its tameness. Their call is a squeaky note.

The nest is placed in a hole in a tree, which is lined with hair, when available, a few feathers and strips of reeds or grass.

They lay three to four green eggs, freckled with light brown forming a cap at the blunt end, and measure 22.5 x 17.5 mm.

Cape Stone Chat. *Saxicola t. torquata.*—A common and widespread species generally seen perched on a dry twig or grass stem, now and then hopping to the ground after insects or catching insects as they fly past. It is found in pairs in open grassland, near water, and appears to occupy a large territory. It has a weak note and utters a lively song in the early morning, otherwise it is a silent bird.

The nest, which is cup-shaped, is built of fine grass stems lined with feathers. The nest is formed in a variety of situations such as in a tuft of grass, in a heap of cut grass, or in a hollow in the ground. It appears to prefer sloping ground or the sloping bank of a stream. When sloping ground is chosen the bird builds up one side of the nest, so that no matter how steep the bank may be the nest is level.

They lay three to four eggs which are pale green, very finely speckled with reddish markings concentrated at the larger end. They measure 18.5-19.5 x 14-14.5 mm.

The thrushes, chats and robins should receive our protection. They are of the greatest economic value, as they feed on the larvae of insects, grubs and also a great variety of insects. Many of the chats frequent cattle kraals and feed on the gorged female ticks found on the ground.

Promising New Grasses for Seeded Pastures in Southern Rhodesia

By OLIVER WEST, D.Sc.,
Senior Research Officer in Charge, Grasslands Research Station.

The most striking deficiency in Southern Rhodesian Agriculture is the lack of improved pastures and the failure to make use of grass leys in arable rotations.

Because the value of improved pastures is generally recognised, there can be little doubt that the pathetically slow increase in the acreage of established pasture is mainly due to the fact that over most of the Colony at present grasses are established by planting roots or runners.

The numerous enquiries received by the Research Stations show that there is in the Colony a great and growing demand for grass seed, which at present cannot be satisfied, for not only is the supply limited, but the varieties obtainable commercially are suitable only for limited areas, where the rainfall is high and well distributed. To meet this need, varieties of pasture grasses suitable for use in seeded pastures over most of the Colony are being developed at Matopos and on the other Research Stations.

This article is a preliminary note on some of the most promising of these new grasses brought into cultivation by the Matopos Research Station.

The arrangement of the descriptions is based on that used in **"Bulletin 39 of the Commonwealth Bureau of Pastures and Field Crops** (1).

The numbers are those of the author's specimens lodged in the Herbaria of the Branch of Botany and Plant Pathology in Salisbury and the Matopos Research Station.

LIST OF PROMISING VARIETIES.

I. **Scientific Name:** *Panicum coloratum* Stapf var *Makarikariensis Goosens.*

Variety or Strain.—Bambatsi.

Common Name.—Bambatsi Panicum.

Collector's No.—O.W. 3172.

Origin.—Roots first collected by the author at **Bambatsi Pan** on the **Manzimnyama** or **Nata River,** in Southern Rhodesia, on 8-10-1946. The Nata River feeds the Makarikari Pan in Bechuana-

land, where the Makarikari Panicum (*P. coloratum* var *Makarikariensis*) was first collected by Pole Evans (3 and 4). The area is semi arid, rainfall probably less than 15 inches, over a short period in summer. The **Bambatsi Panicum** is an important grass on the heavy alluvium of the flood plain, where it occurs in small and in almost pure stands in an open parkland dominated by magnificent **Acacia albida** trees.

The vegetation away from the alluvial flood plain is Mopani Woodland or scrub Mopane (*Colophospermum mopane*).

Characteristics.—Vegetatively very similar to Upright Makarikari, Prinshof strain 11/12, perhaps a little less leafy. Differs markedly in that it seeds freely, producing a heavy crop of well-filled seeds, which germinate easily. It is a long-lived perennial, very erect in habit, producing practically no creeping stems.

Adaptation.—Exhibits a wide range of tolerance to habitat factors. Is very drought resistant but capable of taking full advantage of good seasons and high rainfall. Thrives on heavy black cotton soils but will grow well on all soils that are fertile, throughout the Colony.

Resistance.—No diseases or insect pests observed as yet.

Use.—Grazing, ensilage or hay. Capable of giving very heavy yields on the best soils in good years. Because of its erect habit and the absence of running stems it is easily mown and raked.

Establishment.—Bambatsi Panicum is easily established by seeding. Thus it represents a great advance on the Makarikari strains which are indifferent seeders and which are best established by planting roots or runners.

II. Scientific Name. –*Panicum coloratum* Stapf var *Makarikariensis Goosens.*

Variety or Strain.—Zhilo.

Common Name.—Zhilo Creeping Panicum.

Collector's No.—O.W. 3174.

Origin.—Roots first collected by the author on the sandy banks of the Shashi River opposite Zhilo Hill (Champion Ranch). Here the Shashi River is the boundary between the Colony and the Bechuanaland Protectorate. Zhilo Hill is in Bechuanaland. The vegetation away from the river banks is typical lowveld in which Baobabs (*Adansonia digitata*), *Kirkia acuminata*, *Acacia pallens*, *Commiphora* spp., *Combretum* spp., etc., are common.

Characteristics.—Vegetatively very similar to Creeping Makarikari, Prinshof strain 14/12, quite as leafy but with thicker, more succulent stems. It produces seed, but is not as prolific as Bambatsi. It is a long-lived perennial which runs, the runners rooting at the nodes until it covers the ground, when it grows erect.

Adaptation.—Similar to Bambatsi.

Resistance.—No diseases or insect pests observed as yet.

Use.—Grazing, ensilage or hay. Capable of giving very heavy yields. Its potentialities are still being investigated.

Establishment.—Seed production and establishment by seeding are still under investigation.

III. Scientific Name.—*Urochloa bolbodes* Stapf forma.

Variety or Strain.—Shashi.

Common Name.—Dubi Grass.

Collector's No.—O.W. 2730 and 3221.

Origin.—Collected by the author on the banks of the Shashi, Dubi Ranch, Southern Rhodesia, about 15 miles upstream from Zhilo Hill. It is an important grass on the terrace which lies above the present banks of the river. The terrace is covered by secondary vegetation and appears to have been cultivated formerly. The area is semi-arid, rainfall approximately 15 inches over a short season in summer.

Characteristics.—A long-lived, drought-resistant perennial which roots vigorously, rooting at the nodes. It seeds abundantly. The stem and leaves are very hairy.

Adaptation.—Thrives on fertile sandy soils.

Resistance.—No diseases or insect pests observed as yet.

Use.—Grazing or hay in the drier parts of the Colony. It should be most useful for pasture establishment and for revegetating denuded areas in the more arid regions.

Establishment.—Seed production and establishment by seeding are still under investigation.

IV. Scientific Name.—*Chloris gayana* Kunth.

Variety or Strain.—Katambora.

Common Name.—Katambora Rhodes Grass.

Collector's No.—O.W. 3219.

Origin.—Seed first collected by the author and W. R. Schwim on the Northern Rhodesian bank of the Zambesi at Katambora, where it occurs in pure stands in open glades adjoining the Riverine Forest. The Riverine Forest gives way to Mopani Woodland with Rhodesian Teak (*Baikea plurijuga*) on the high ground away from the river.

The rainfall is approximately 25 inches, all in summer. The temperatures both day and night are very high. Frosts do not occur. (**Note.**—Extensive stands of Rhodes grass occur in valley bottoms and vleis throughout the north-western corner of the Colony. Notable localities are Lubimbi on the Shangani and vleis near Robyn's in the Wankie Game Reserve.)

Characteristics.—A tall and exceptionally leafy form. When seeded thinly it produces strong runners which cover the ground

quickly. Without any doubt the finest Rhodes grass tried at Matopos. It produces heavy crops of very good seed.

Adaptation.—Preliminary observations indicate that this variety will considerably extend the range of Rhodes grass in the Colony. It appears to be more drought resistant and to have a wider range of adaptation than either **Commercial Rhodes Grass** or **Giant Rhodes Grass.** It is being tried against other varieties in various parts of the Colony.

Resistance.—No diseases or insect pests observed as yet.

Use.—Grazing, hay or ensilage. Capable of very heavy yields on good soil.

Establishment.—It is easily established from seed.

V. Scientific Name.—*Chloris gayana* Kunth.

Variety or Strain.—Zongala.

Common Name.—Zongala Rhodes Grass.

Collector's No.—O.W. 3217.

Origin.—Seed collected by the author and T. D. Kennan at the Zongala Hot Springs (Chloride Waters), Zambesi Valley, Sebungwe District, 12-9-1949. The locality is about 1¾ miles from the south bank of the Zambesi River, four miles below Mosanga Island, near Fulanka's Kraal, and about 12 miles from Chief Binga's Kraal.

Characteristics.—The grass has a xerophytic appearance with thin folded leaves. It is a very late flowering variety. In cultivation at Matopos—flower heads begin to appear in April and are always caught by the first frosts. For this reason we have been unable to obtain any seed. The variety is now being cultivated at Marandellas and will be grown at Nyamandhlovu for seed production.

Adaptation.—The variety shows promise for the more arid areas and for alkaline soils.

Resistance.—No diseases or insect pests observed as yet.

Use.—Its potentialities are still under investigation. Shows promise for use in the hot dry areas and as material for breeding more drought resistant varieties of Rhodes Grass.

VI. Scientific Name.— *Cenchrus ciliaris* Linn.

Variety or Strain.—Chipinga.

Common Name.—Chipinga Foxtail.

Origin.—Seed was originally obtained from a farmer in the Chipinga area.

Characteristics.—A fine leafy variety, not quite as tall as the widely cultivated Zeerust variety (2) but a more reliable seeder, producing good crops of viable seed.

Bambatsi Pan on the Manzimnyama. Note the luxuriant growth of the *Bambatsi Panicum*. The trees are Mopani.

Young stand of the *Bambatsi Panicum* at the Matopos Research Station.

Young stand of the *Bambatsi Panicum* at the Matopos Research Station.

First year stand of *Zhilo Creeping Panicum* at the Matopos Research Station.

First year stand of *Zhilo Creeping Panicum* at the Matopos Research Station.

Adaptation.—Like the variety Zeerust it is adapted to a wide range of soils and rainfall.

Resistance.—No diseases or insect pests observed as yet.

Use.—Grazing, hay or ensilage. Capable of very heavy yields.

Establishment.—Easily established from seed. Seed is most easily cleaned by hammer mill, and the clean seed can be drilled.

VII. Scientific Name.—*Cenchrus ciliaris* Linn.

Variety or Strain.—Manzimnyama.

Common Name.—Manzimnyama Foxtail.

Collector's No.—O.W. 3175.

Origin.—Seed originally collected by the author in dry Mopane scrub on the Manzimnyama near Bambatsi. The area is semi arid, rainfall probably less than 15 inches, over a short period in summer. Unlike Bambatsi Panicum it does not occur on the flood plain, but in the much drier, scrub mopane, west of the Manzimnyama.

Characteristics.—A dwarf variety with purple inflorescences. Involucral bristles well developed and curly. Purple from the base. The uncleaned seed (clusters of spikelets) when stripped and viewed in mass is a deep purplish colour.

Adaptation.—The variety shows promise for use in the more arid regions.

Resistance.—No diseases or insect pests observed as yet.

Use.—The potentialities of the variety are still under investigation. It shows promise for use in the hot dry areas and as breeding material.

VIII. Scientific Name.—*Cenchrus ciliaris* Linn.

Variety or Strain.—Sebungwe.

Common Name.—Sebungwe Foxtail.

Collector's No.—O.W. 3173.

Origin.—Seed originally collected by the author and T. D. Kennan near the fossil site on Sampakwe Hill in the Sebungwe District 12-9-1949.

Characteristics.—A dwarf variety very similar to, but distinguishable from, the **Manzimnyama Foxtail.** Inflorescences only tinged with purple. Spikes denser with smaller clusters of spikelets. Involucral bristles less well developed, straighter with pale base. The uncleaned "seed" (clusters of spikelets) when stripped and viewed in mass is pale in contrast to the purple of the Manzimnyama.

Adaptation.—Under investigation. Apparently very similar to that of the Manzimnyama variety.

Resistance.—No diseases or insect pests observed as yet.

Use.—Under investigation. See notes under **Manzimnyama Foxtail.**

IX. Scientific Name.—*Echinochloa pycamidalis* Hitchc and Chase.

Variety or Strain.—Sihubu.

Common Name.—Sihubu Antelope Grass.

Collector's No.—O.W. 3223.

Origin.—Plants collected by the author at Sihubu on the Manzimnyama (on the Flood Plain near Bambatsi. See Bambatsi Panicum No. I.) 21-8-1949.

Characteristics.—The leaves and stems are hairless, and for this reason the present variety is a great improvement on the older "Limpopo" and "Nata River" varieties (2). It attains a height of approximately 10 feet and, like the older varieties, is very woody when mature. Its seeding characteristics are under investigation.

Adaptation.—Similar to that of the older strains. Very tolerant of extremes of drought and wetness. A useful grass for areas liable to temporary flooding.

Resistance.—No diseases or insect pests observed as yet.

Use.—Grazing or ensilage. Capable of giving heavy yields. Its potentialities are still under investigation.

CONCLUSIONS.

1. Of the varieties described three are outstanding:

No. 1. Bambatsi Panicum.

No. 2. Katambora Rhodes Grass.

No. 3. Chipinga Foxtail.

Compared as grazing or by yield of hay or ensilage, they are as good or better than similar non-seeding varieties at Matopos; over and above this, they exhibit a great advantage in that all three varieties produce good crops of viable seed and are easily established on a field scale by seeding. They appear to have a wide range of adaptation and to be suitable for use over most of the Colony.

2. Four Varieties:

No. III. Dubi Grass,

No. V. Zongala Rhodes Grass,

No. VII. Manzimnyama Foxtail, and

No. VIII. Sebungwe Foxtail,

exhibit characteristics which make them particularly suitable for use in the more arid regions. They are free seeders and easily established by seeding.

3. The remaining two varieties:

No. II. Zhilo Panicum and

No. IX. Sihubu Antelope Grass

show great promise and are superior in certain respects to existing and similar cultivated varieties.

SEED PRODUCTION AND CERTIFICATION.

The new varieties described in this article will, it is hoped, go a long way towards making possible the successful establishment of pastures by seeding throughout the Colony; but before this object can be achieved it will be necessary to develop the commercial production of seed supplies. Already several interested farmers are engaged in the production of seed of the Bambatsi Panicum and of Katambora Rhodes Grass, and soon supplies of seed of these two varieties and of the other varieties described should be on the open market. There should be no need to emphasise the great need for a scheme of **Seed Registration and Certification** by which the purity of the varieties can be maintained and the interests of both grower and purchaser safeguarded.

SUMMARY.

Although there is a great demand for grass seed for pasture establishment in this Colony, the supplies available commercially are very limited and the varieties suitable only for limited areas where the rainfall is high and well distributed.

To meet this need, new varieties of pasture grasses suitable for use in seeded pastures over most of the area of the Colony have been developed at Matopos.

These varieties are described.

The need for the development of commercial seed production and the institution of a scheme of seed certification for the protection of both grower and purchaser is stressed.

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A Simple Statistical Significance Test

By D. VAN DER REYDEN, Statistician.

1. Introduction.

The reasoning involved in an ordinary test of significance, say in a test whether two observed means differ significantly, is somewhat as follows: On the null hypothesis that both samples originated from a common parent population, the sampling distribution of the differences between the means is derived. This is done by repeatedly drawing two samples at random from the postulated parent population, obtaining the difference between the two means at each draw, and classifying these differences into a frequency distribution. If it is now required to test the difference between two observed means for significance, this difference will be an item of the sampling distribution and the probability of its occurrence under the null hypothesis can be calculated. If this probability is less than certain conventionally accepted significance levels, usually the 5% or 1% levels, the null hypothesis is rejected, and the experimenter will conclude that the samples came from different parent populations. In other words, he will conclude that the sample means differ significantly.

The determination of the sampling distribution is a highly complex mathematical process, but this does not ordinarily concern the experimenter who is usually presented with the ready-made product in the form of convenient standard tables. Apart from ensuring that the design of the experiment is in conformity with the requirements of the hypothesis to be tested, the only contribution the experimenter has to make is the labour involved in the numerical computations. Calculation of the sums of squares forms the major part of this labour.

In this paper it is shown that two groups can be compared in a valid way without using the sums of squares at all. Standard tables, facilitating this process and covering most cases likely to appear in practice, are presented.

2. Use of Ranks.

Given two samples consisting of n and m-n observations respectively. If, as can be expected with small samples, all m observations have different magnitudes, they can be ranked in order of magnitude from the smallest to the largest value. Assigning the ordinal number *1* to the smallest observation and the ordinal number m to the largest observation, each observation will have its own rank and each sample will have a certain configuration of ranks. In the example below, for instance, the

rank *5* means that the native steer with carcase weight of 568 pounds is the fifth lowest of the *22* animals in the experiment.

The rank, therefore, assigns the position of a specific observation relative to all observations in the experiment. If all the ranks in the first group exceed all the ranks in the second group, all magnitudes of the observations in the first group must exceed all magnitudes of observations in the second group. Consequently the mean of the original observations in the first group must exceed the mean of the second group. If most of the ranks of the first group exceed those of the second group, the mean of the original observations in the first group will also exceed the mean of the second group. It follows that if the *sum* of the ranks in the first group exceeds the sum of the ranks in the second group, taking into account the number of observations in each group, the mean of the original data in the first group will exceed the corresponding mean of the second group. The same type of argument applies if the ranks of the first group are less than the ranks of the second group.

The sums of ranks therefore indicate the relative sizes of the mean values of the original data in the two groups. Since the sums of ranks of the two groups are complementary, it is only necessary to study the behaviour of one of the rank sums. In this paper the sums of ranks of the *smallest* sample are studied.

If samples of sizes n and m-n are repeatedly drawn from a parent population and ranks attached to the observed magnitudes in the described manner, the total possible number of different ranking patterns for this sample will be the number of times n objects can be selected from m objects or $\binom{m}{n}$. For each ranking pattern of this sample, there will naturally be a complementary one for the other sample.

If T be defined as the total of the ranks of the sample of n observations, the $\binom{m}{n}$ possible configurations of ranks will generate a frequency distribution of T values, and it will become possible to determine the probability of occurrence of any given T value. In practice it will be more useful to determine, for given combinations of m and n, standard values of T at certain significance values. Any observed value of T from an experiment can then be compared with these standard values and will be regarded as significant if lying beyond these values. In this case the null hypothesis of a common parent population will be rejected, and the conclusion drawn that the two groups differ significantly at the selected probability level.

3. The Permutation Distribution of T.

This distribution of T thus has the same function as the sampling distribution in the ordinary parametric significance tests. Since, however, it is derived from the samples and not from the parent population, it will be better to distinguish it from the sampling distribution by terming it the *permutation* distribution.

To determine standard values of T for specific probability levels, either the distribution law or the actual frequencies of the distribution must be known. Study of the moments of the permutation distribution will show that it will not be easy to determine the exact distribution law, if it can be done at all.

Utilizing the well-known results for the moments of the means of samples taken from a finite population, it will be found that all odd moments of the permutation distribution, excepting the first, are identically zero. The second and fourth moments are given by the formulae—

$$M_2 = \frac{1}{12} n (m-n)(m+1) \qquad (1)$$

$$M_4 = \frac{1}{20} M_2 \left[n(m-n)(5m+7) - 2n(m+1) \right] \qquad (2)$$

so that the measure of kurtosis becomes—

$$B_2 = 3 \left[1 + \frac{2}{5} \left\{ \frac{1}{m+1} - \frac{1}{n} - \frac{1}{m-n} \right\} \right] \qquad (3)$$

The distribution is thus symmetrical about its mean which will be found to be $\frac{1}{2}n(m+1)$. From formula (3) it is easily seen that B_2 will always be less than *3* and that, consequently, T is not normally distributed. For a normal distribution B_2 is identically equal to *3*. A Pearson Type II would appear to be the best empirical approximation, but it was found easier in practice to calculate the actual frequencies of the permutation distributions for various combinations of m and n directly.

Since we are sampling from the m natural numbers, the terminal values of the distribution of T will be given by

$1 + 2 + \ldots + n = \binom{n+1}{2}$ and by $m + (m-1) + \ldots + (m-n+1) = \binom{n+1}{2} + n(m-n)$.

Commencing the sampling process with $n = 1$, that is, taking all samples of one item from m, all values of T between the the terminal points will have a frequency of *1*. To obtain the frequencies for samples of *2* items, use is made of the binomial coefficient identity—

$$\binom{m+1}{2} = \binom{1}{1} + \binom{2}{1} + \ldots + \binom{m}{1} \qquad (4)$$

For samples of *3* or more items, similar identities are employed. The process can be routinised by rotating all frequencies for samples of *1* for the different values of m clockwise through 45°, shifting the whole system to the new terminal value, adding horizontally, and repeating the process for the values thus found. Table I illustrates the method.

TABLE I.

Determination of Permutation Distribution Frequencies.

					Samples of Two								Samples of Three							
m / T	1	2	3	4	2	3	4	5	2	3	4	5	3	4	5	6	3	4	5	6
1	1	1	1	1																
2		1	1	1																
3			1	1	1				1	1	1	1								
4				1		1				1	1	1								
5						1	1			1	2	2								
6							1	1			1	2	1				1	1	1	1
7							1	1			1	2		1				1	1	1
8								1				1		1	1			1	2	2
9								1				1		1	1	1		1	2	3
10															2	1			2	3
11															1	2			1	3
12															1	2			1	3
13																2				2
14																1				1
15																1				1
Total		2	3	4					1	3	6	10					1	4	10	20

Several checks can be applied to the calculations. Each frequency distribution should be symmetrical about its mean, the frequencies should add up to the value $\binom{m}{n}$, and the individual frequencies of the $\binom{m}{n}$ combinations should be the same as those of the $\binom{m}{m-n}$ combinations.

4. Tables of Standard Values of T.

The selection of a certain significance level, say 5%, implies the determination of a lower and an upper value of T such as that 5% of the area of the permutation distribution lies beyond these T values. This is illustrated in Figure I for the case m=14, n=7.

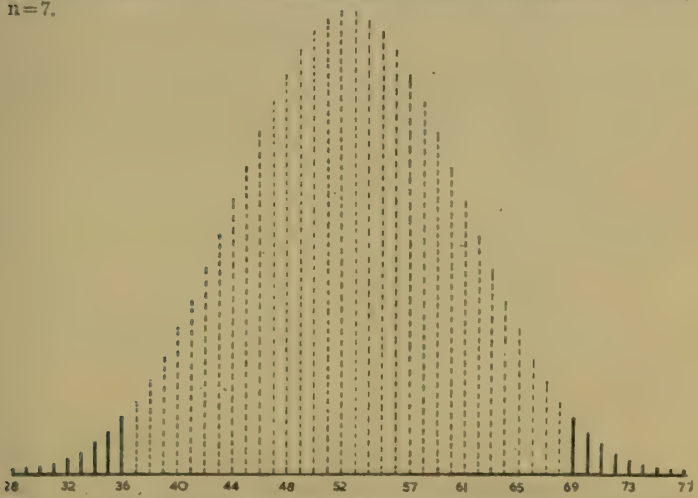

Fig. 1.—Permutation Distribution of T for the case m 14, n 7. Unbroken vertical lines indicate those frequencies the sum of which forms 5% of the total.

The lower value of T, at the 5% level for instance, is obtained by summing the frequencies from the extreme left of the distribution till that point is reached where their sum is equal to or just less than $2\frac{1}{2}$% of the total area. In discrete frequency distributions the total area is equal to the total number of observations. Because of the symmetry of the distribution, the upper value of T can be determined in a similar way. The tables in the Appendix supply the required values of T at significance levels of 1%, 2%, and 5%. In these tables "L" means lower and "U" means upper values of T.

5. Example and Discussion.

To illustrate the practical application of this test, the carcase weights of Native and European cattle are given in Groups I and II of Table II. The ordinary t-test, by means of an analysis of variance, shows that the difference between the two means is significant at P = 1%.

TABLE II.

Carcase Weights of Steers.

	Group I.		Group II.	
	Obser.	Rank.	Obser.	Rank.
	545	2	510	1
	552	3	588	11
	563	4	716	18
	568	5	728	19
	569	6	729	20
	570	7	730	21
	585	8	748	22
	586	9	—	—
	587	10	—	—
	589	12	—	—
	605	13	—	—
	610	14	—	—
	620	15	—	—
	621	16	—	—
	642	17	—	—
Total	8,812	141	4,749	112
Mean	588	—	678	—

To apply the ranking test, arrange the observations in each group from the lowest to the highest and assign the ranks in terms of all the *22* observations. Sum the ranks in the group containing the smallest number of observations, and refer to the standard tables.

From the standard tables for $n = 7$ and $m = 22$, the required T values at the 5% level are 42 and 96, at the 2% level 47 and 114, and at the 1% level 44 and 117. The T value found from the experiment, 112, is significant at the 5% level and just misses significance at the 2% level. On the basis of either the t-test or the T-test, the null hypothesis is rejected and we conclude that Groups I and II differ significantly.

An interesting and useful application of this test in experimental design is the determination of the numbers of experimental units necessary in the two groups to obtain a required precision. For a variety of reasons, it is preferable to use equal numbers in the two groups, but it is not always possible to observe this requirement in practice. If the precision required is that of two equally-sized groups, the following scheme gives those combinations of unequal numbers with approximately the same precision.

5,5	4,7	3,10	—	—	—
6,6	5,8	4,10	3,16	—	—
7,7	6,9	5,11	4,15	3,26	—
8,8	7,10	6,12	5,15	4,22	3,41
9,9	8,11	7,12	6,15	5,20	4,31
10,10	9,12	8,13	7,16	6,20	5,27

The precision of the example above, where groups of 15 and 7 animals were employed, is thus approximately the same as that of an experiment with 10 animals in each group.

The efficiency of the test proposed in this paper has still to be studied in terms of other tests, and until this has been done rigid conclusions from the given tables should be avoided.

Appendix.

STANDARD TABLES FOR *T* AT DIFFERENT SIGNIFICANCE LEVELS.

5% Significance Level.

n	2		3		4		5		6		7		8		9		10		11		12	
m	L	U	L	U	L	U	L	U	L	U	L	U	L	U	L	U	L	U	L	U	L	U
10	3	19	7	26	12	32	17	38														
11	3	21	8	28	13	35	18	42														
12	3	23	8	31	14	38	20	45	26	52												
13	4	24	9	33	14	42	21	49	27	57												
14	4	26	9	36	15	45	22	53	29	61	36	69										
15	4	28	10	38	16	48	23	57	31	65	38	74										
16	4	30	10	41	17	51	24	61	32	70	40	79	49	87								
17	4	32	11	43	18	54	26	64	34	74	42	84	51	93								
18	4	34	11	46	19	57	27	68	35	79	44	89	53	99	62	109						
19	5	35	12	48	20	60	28	72	37	83	46	94	55	105	65	115						
20	5	37	12	51	21	63	29	76	38	88	48	99	58	110	68	121	78	132				
21	5	39	13	53	21	67	30	80	40	92	50	104	60	116	71	127	81	139				
22	5	41	13	56	22	70	32	83	42	96	52	109	62	122	73	134	84	146	98	155		
23	6	42	14	58	23	73	33	87	43	101	54	114	65	127	76	140	88	152	103	161		
24	6	44	14	61	24	76	34	91	45	105	56	119	67	133	79	146	91	159	107	168	118	182
25	6	46	15	63	25	79	35	95	46	110	58	124	70	138	82	152	94	166	110	176	122	190
26	6	48	15	66	26	82	37	98	48	114	60	129	72	144	84	159	97	173	114	183	127	197
27	6	50	16	68	27	85	38	102	50	118	62	134	74	150	87	165	100	180	118	190	131	205
28	7	51	16	71	27	89	39	106	51	123	64	139	77	155	90	171	103	187	121	198	135	213
29	7	53	17	73	28	92	40	110	53	127	66	144	79	161	93	177	107	193	125	205	140	220
30	7	55	17	76	29	95	42	113	54	132	68	149	81	167	95	184	110	200	128	213	144	228

2% Significance Level.

n	3		4		5		6		7		8		9		10		11		12	
m	L	U	L	U	L	U	L	U	L	U	L	U	L	U	L	U	L	U	L	U
10	6	27	11	33	16	39														
11	6	30	11	37	17	43														
12	7	32	12	40	18	47	24	54												
13	7	35	13	43	19	51	25	59												
14	7	38	13	47	20	55	27	63	34	71										
15	8	40	14	50	21	59	28	68	35	77										
16	8	43	15	53	22	63	29	73	37	82	45	91								
17	8	46	15	57	23	67	30	78	39	87	47	97								
18	9	48	16	60	24	71	32	82	40	93	49	103	59	112						
19	9	51	17	63	25	75	33	87	42	98	51	109	61	119						
20	10	53	17	67	26	79	34	92	44	103	53	115	63	126	74	136				
21	10	56	18	70	27	83	36	96	45	109	56	120	66	132	77	143				
22	10	59	19	73	28	87	37	101	47	114	58	126	68	139	79	151	93	160		
23	11	61	19	77	29	91	39	105	49	119	60	132	71	145	82	158	96	168		
24	11	64	20	80	30	95	40	110	51	124	62	138	73	152	85	165	100	175	111	189
25	12	66	21	83	31	99	41	115	52	130	64	144	76	158	88	172	103	183	116	196
26	12	69	21	87	32	103	43	119	54	135	66	150	78	165	91	179	107	190	120	204
27	12	72	22	90	33	107	44	124	56	140	68	156	80	172	93	187	110	198	124	212
28	13	74	23	93	34	111	45	129	58	145	70	162	83	178	96	194	113	206	127	221
29	13	77	23	97	35	115	47	133	59	151	72	168	85	185	99	201	117	213	131	229
30	13	80	24	100	36	119	48	138	61	156	74	174	88	191	102	208	120	221	135	237

1% Significance Level.

n	3		4		5		6		7		8		9		10		11		12	
m	L	U	L	U	L	U	L	U	L	U	L	U	L	U	L	U	L	U	L	U
10	—	—	10	34	15	40														
11	—	—	10	38	16	44														
12	6	33	11	41	16	49	23	55												
13	6	36	11	45	17	53	24	60												
14	6	39	12	48	18	57	25	65	32	73										
15	7	41	12	52	19	61	26	70	34	78										
16	7	44	13	55	20	65	27	75	35	84	43	93								
17	7	47	13	59	21	69	28	80	37	89	45	99								
18	8	49	14	62	22	73	30	84	38	95	47	105	56	115						
19	8	52	15	65	22	78	31	89	40	100	49	111	58	122						
20	8	55	15	69	23	82	32	94	41	106	51	117	61	128	71	139				
21	8	58	16	72	24	86	33	99	43	111	53	123	63	135	73	147				
22	9	60	16	76	25	90	34	104	44	117	54	130	65	142	76	154	89	164		
23	9	63	17	79	26	94	36	108	46	122	56	136	67	149	79	161	93	171		
24	9	66	18	82	27	98	37	113	47	128	58	142	69	156	81	169	96	179	107	193
25	10	68	18	86	28	102	38	118	49	133	60	148	72	162	84	176	99	187	111	201
26	10	71	19	89	29	106	39	123	50	139	62	154	74	169	86	184	102	195	115	209
27	10	74	19	93	29	111	40	128	52	144	64	160	76	176	89	191	105	203	119	217
28	11	76	20	96	30	115	42	132	53	150	66	166	78	183	92	198	108	211	122	226
29	11	79	20	100	31	119	43	137	55	155	68	172	81	189	94	386	111	219	126	234
30	11	82	21	103	32	123	44	142	57	160	70	178	83	196	97	213	114	227	129	243

Protection of Dams by Fencing

By THE DEPARTMENT OF NATIVE AGRICULTURE.

Perimeter fencing of dams with the provision of drinking corridors was introduced in Chibi Reserve several years ago and results have been most satisfactory. This method has also been used elsewhere. It is agreed that where an outlet pipe is provided it is best to water below the wall as the danger of internal parasites is reduced. The drinking trough should be suitably sited well away from the wall of the dam, but erosion may be extensive when large numbers of cattle are watered, unless appropriate conservation measures are taken.

Where no outlet pipes are provided the corridor system, which is illustrated in Diagram 1, is a good solution to the problem.

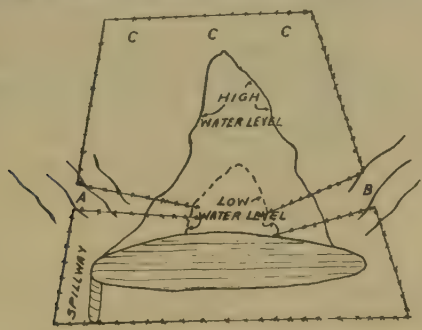

DIAGRAM 1

Corridors A and B are set out on the contour and they are protected by low, broad ridges which spill water on to safe ground on either side. It may be necessary to stone pave the corridor near the water. Two corridors are sufficient for the smaller dams; three or more are necessary for larger dams. Each year one corridor may be fenced off during the rainy season to encourage a grass cover. The width of the corridor at its opening may be 50 yards and upwards, depending on the number of cattle which are watered at one time, and the corridor should not narrow too much near the water. If any difficulty is encountered in getting a straining post to hold in the bed of the dam at E the following method may be used.

Corridor fences are sited on either side of the dam directly opposite one another. Use straining posts long enough to project a foot or two above high water level.

Between two opposite straining posts, stretch double twisted No. 8 plain wire (or double 12½ gauge barbed wire) at the top of the posts, then strain the top wire from one corridor fence, but not too tightly. Strain the top wire from the opposite fence until both wires are tight. If two strainers are available, both

wires may be strained, simultaneously. Continue straining wires from either side alternately. See Diagram 2.

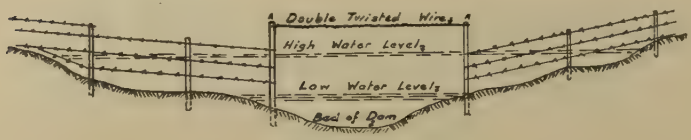

DIAGRAM 2

The double twisted wire should be above high water level when tight. As an additional safeguard against these posts going over sideways, the tripod principle may be adopted. See Diagram 3

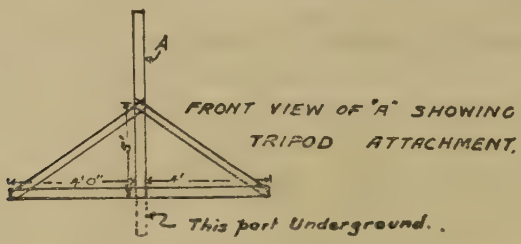

DIAGRAM 3

If dams are likely to go completely dry periodically, the drinking corridors may be connected, i.e., the corridors form a complete lane through the floor of the dam. This ensures that no stock can get into the fenced area when the dam is dry.

Where exceptionally large numbers of stock are watered and fencing supplies permit, a double lane corridor may be used. The lanes are closed alternately for a full rainy season to permit a certain amount of natural recovery to take place and to allow consolidation of repairs to conservation works within the corridor. The lanes must be the same width at the entrance in order that the same "gate" wire sealing the entrance may be used over and over again.

A good time to carry out this fencing is during the period when water supplies are at their lowest, as the corridors extend down to the low level water mark. Fencing below the dam wall should be well below the toe of the wall. The water may be treated for the control of internal parasites.

Results are as follows:—

1. The wall of the dam is protected.
2. The growth of vegetation around the perimeter of the dam reduces siltation.
3. Watering stock at controlled points (which are protected) also reduces siltation of the dam.

4. The dense growth of vegetation at C acts as a vegetation filter. This reduces siltation from the catchment area but does not remove the need for protection work in the catchment area.

5. The water remains clear and is better for the cattle, while suitable fish species will flourish in the dam.

It must be recognised that in addition to this protection there is the need to herd cattle away from the vicinity of a dam after they have watered. If cattle remain in large numbers in the vicinity of a dam the grass cover disappears and the surface soil is reduced to a fine powder. With the first rains there is excessive run-off and so much silt is carried down by water that the vegetation encouraged by perimeter fencing will not protect a dam from siltation. Dams are watering points and not "holding points." The practice in Native Areas of holding cattle in the vicinity of dams for lengthy periods during the dry season is responsible for more siltation than any other single practice.

The corridor system may well be applied as part of river fencing schemes. An example is the Tjankwa River in the Nata Reserve, where a survey of good waterholes in the river bed was made at the driest part of the year. Drinking corridors were then provided with the rest of the river fenced off. Where possible rocky approaches were chosen to minimise artificial protection work in the corridors.

The corridor system has also been usefully employed for dipping tanks in Lundi Reserve, Nata Reserve and elsewhere. Two corridors to the entrance kraal are fenced off on the contour and these are used alternately. Protection work may be done in the corridors which need not be lengthy. This system does reduce erosion in the immediate vicinity of dipping tanks where large numbers of cattle are dipped.

NOTICE

FARM TIMBER USED FOR MINING PURPOSES.

When any timber required by a miner is not cut by the miner himself or by his servants, the occupier of the land supplying the timber has the first option of cutting and transporting such timber (and converting it to charcoal if so required) on terms to be mutually agreed upon. Where there is no agreement, the matter is referred to a **Disputes Board,** the Chairman of which is a Magistrate, which decides on what terms and conditions and within what time the occupier of the land may exercise his option.

A. E. ROMYN,
Secretary for Agriculture and Lands.

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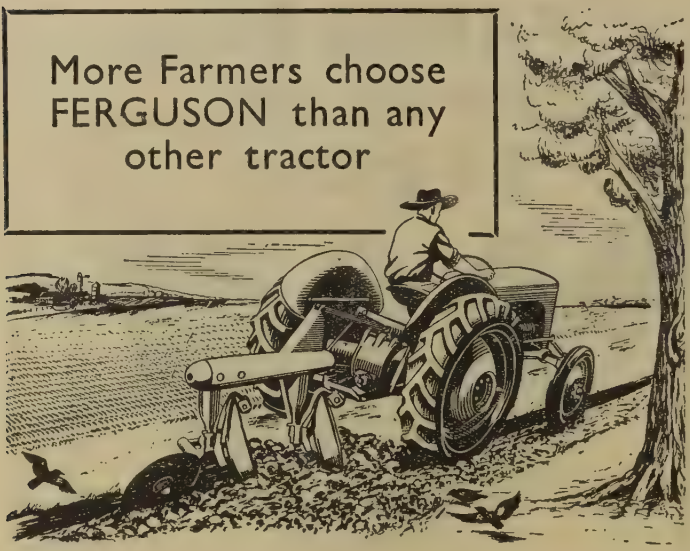

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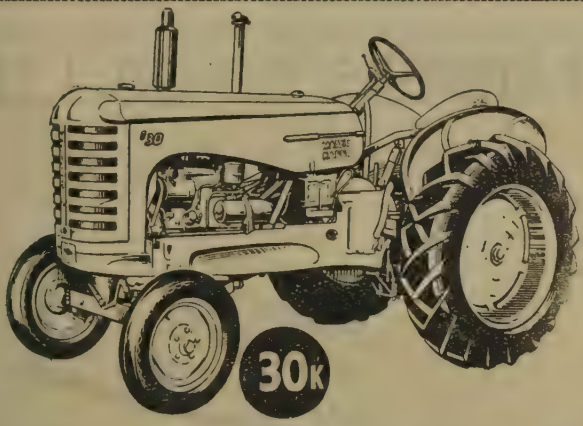

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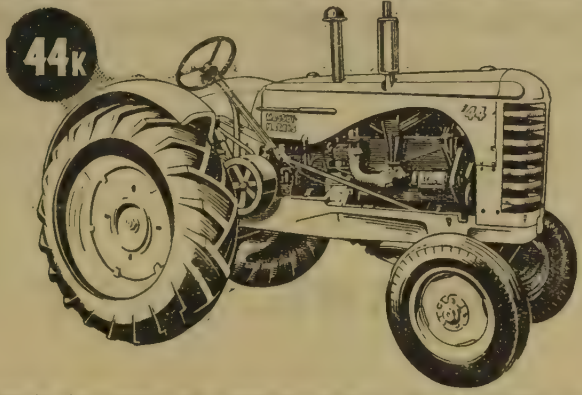

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